06-12-00 A

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Title of Invention	Method and System for Monitoring and Transmitting Utility Status Via Universal Communications Interface
Named Inventor(s)	Mark Leach
Attorney Docket	12900-0100
Express Mail Label No.	EL397834771US

JC714 U.S. PTO 09/591258 06/09/00

00/60/90 856 U.S. PTO

APPLICATION ELEMENTS

1. ☐ Fee Transmittal Form
   (Submit an original, and a duplicate for fee processing)
2. ☒ Specification, Claims, and Abstract — Total Pages 16
3. ☒ Drawings — Total Sheets 2
4. Oath or Declaration — Total Pages
   a. ☐ Newly executed (original or copy)
   b. ☐ Copy from prior application (37 CFR 1.63(d))
   (for continuation/divisional with Box 17 completed)
   [Note Box 5 Below]
   (i) ☐ DELETION OF INVENTOR(S)
   Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation by Reference
   (usable if Box 4b is checked)
   The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. ☐ Microfiche Computer Program *(Appendix)*
7. ☐ Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. ☐ Computer Readable Copy
   b. ☐ Paper Copy (identical to computer copy)
   c. ☐ Statement verifying identity of above copies

ADDRESS TO: Assistant Commissioner for Patents
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ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment:
   a. ☐ Assignment Papers (cover sheet & document(s))
   b. ☐ Assignment is of record in parent application No. _____
9. ☐ 37 CFR 3.73(b) Statement *(when there is an assignee)*
   ☐ Power of Attorney by assignee
10. ☐ English Translation Document *(if applicable)*
11. ☐ Information Disclosure Statement (IDS) PTO-1449
    ☐ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503)
    (Should be specifically itemized)
14. ☐ Small Entity Statement(s)
    ☐ Statement filed in prior application Status still proper and desired
15. ☐ Certified Copy of Priority Document(s)
16. ☐ Other: _____

17. If a **CONTINUING APPLICATION**, *check appropriate box and supply the requisite information*:
    ☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No:

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METHOD AND SYSTEM FOR MONITORING AND TRANSMITTING UTILITY STATUS VIA UNIVERSAL COMMUNICATIONS INTERFACE

TECHNICAL FIELD

The present invention relates generally to automated meter reading. More particularly, the present invention relates to an automated meter for collecting data and communicating with a remote site.

BACKGROUND OF THE INVENTION

Automated meter reading (AMR) devices are often configured to transmit data relating to utility usage parameters to a remote location, such as a utility company. An AMR device may be a retro-fit device or a solid-state device. A retro-fit AMR device attaches to an existing utility meter and includes functionality to read the existing utility meter, transform the meter reading into usable data and transmit the data to a remote location. Solid-state AMR devices are designed to replace the existing utility meter and are attached directly to the utility line to measure utility usage data.

A significant drawback of prior art AMR devices is that they are functionally limited in their communications options and are thus not generally adaptable to evolving communications technology. AMR devices are typically constructed with hardware and/or software components for transmitting and receiving AMR data over a single communications medium. Some prior AMR devices may be equipped with components for transmitting and receiving AMR data over a finite number of communications media. However, as communications technology advances and new and different communications mediums are selected for the transmission of AMR data, incompatible AMR devices must be replaced at great expense to the utility companies. Unfortunately, the cost of replacing incompatible AMR devices is often passed on to the consumer.

Therefore, there remains a need in the art for an AMR device that is able to adapt to evolving communications technology by being operable to transmit and receive AMR data via any communications medium.

SUMMARY OF THE INVENTION

Generally stated, the present invention is directed to a method and system for providing notification of utility status to a remote location. Typically, this notification takes the form of a meter reading message, including such information as power outage, low voltage, or the current meter reading. The present invention provides a device for transmitting status information to a utility or other end user regarding the current status of a utility meter. An exemplary embodiment of the present invention may be recognized as a system including at least one input, a microprocessor, a

universal bus, a universal serial port, and at least one communications slot.

The system is attached (either physically or via a remote connection) to the utility meter, from which an input signal is received. The system is additionally connected to an output device, such as a radio frequency transmitter, a modem, a coaxial cable, and so on. These output devices communicate with a system microprocessor through the use of a universal communications interface and a universal bus. The universal communications interface is connected to one or more slots, which are operative to accept various forms of output devices. The universal communications interface is equipped with "plug and play" technology, so that the interface may recognize a connected output device and relay signals between the microprocessor and output device in the proper data format.

Generally, the system transmits a status message containing the current meter reading and/or any trouble condition via the connected output device to a receiver, so that the status of the monitored utility may be instantly known at a remote location. Specifically, the microprocessor monitors the input signal for a trouble condition. A "trouble condition" is typically defined as a specific value which the input signal must not exceed or fall below. In the event that the trouble condition is reached, the microprocessor transmits a status message of a type in accordance with its programming. The microprocessor sends the status message across the universal bus to the universal communications interface, which in turn modifies the data format of the status message such that an output device connected to the slot may accept and relay the message.

That the invention improves over the drawbacks of prior document classification systems and accomplishes the advantages described above will become apparent from the following detailed description of the embodiments and the appended drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a signal flow block diagram displaying field use of an exemplary automated meter reading system in accordance with an exemplary embodiment of the present invention.

FIG. 2 is a functional block diagram of an exemplary automated meter reading system in accordance with an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENT

The exemplary embodiment relates to a system for automated meter reading (AMR). The AMR system 100 of the present invention is equipped with a universal communications bus coupled to a universal communications port, which allows the device to operate with interchangeable communications devices. The AMR system 100 is also equipped with "plug and play" technology, so that the AMR system 100 is able to recognize and communicate with a variety of communications devices that may be plugged into its universal communications port. Accordingly, with proper configuration, an appropriate communications device may be plugged into the AMR system 100 to enable the transmission and reception of AMR data over any given type of communications medium. Of course, the communications medium selected by the utility company for AMR transmission and reception dictates the

type of communications device that must be plugged into the AMR system 100.

The following description of exemplary embodiments of the present invention will refer to the drawing, in which like numerals indicate like parts throughout the several figures. The exemplary embodiments will be discussed with particular reference to an AMR system 100 adapted for power. However, it should be kept in mind that the present invention may also be adapted for other types of utilities, such as water and gas.

FIG. 1 displays a signal diagram of an exemplary AMR system 100 in accordance with the present invention. As shown, the exemplary AMR system may accept data inputs from multiple sources, and send data through multiple output connections in a variety of data formats. FIG. 1 is intended only to show a possible use of the exemplary embodiment, and accordingly the figure and following text should be regarded as an illustration rather than limitation of use.

The AMR system 100 may be connected to a variety of meters, such as an electric meter 110, water meter 120, gas meter 130, and so on. One AMR system may be used to monitor multiple meters, or each meter may have a dedicated system connected. Further, the AMR system 100 may accept additional signals from utilities such as a tamper detection monitor 116, a voltage monitor 117, an outage notification monitor 118, or a reconnect/disconnect monitor 119. Alternately, the AMR system may have built-in functionality to monitor these events.

The AMR system 100 receives input data from the monitored meters in a variety of formats. Typically, the data takes the form of a voltage or current level present in a given meter, although alternate embodiments may accept radio frequency (R/F)

data, pressure level, temperature, and so on. When this input signal reaches a certain threshold for a specific period of time, the AMR system 100 transmits a notification signal via a connected output device to a receiving device.

Sample output transmissions include a R/F transmission 101, a DTMF signal sent across a telephone network 102, or a data signal transmitted through a computer I/O port 103, such as a serial, parallel, or USB port. The AMR system may be programmed to transmit on one or more connected devices in one or more signal formats. Exemplary receiving devices include a pager 140, a personal computer 150, a facsimile machine 160, a utility billing system 170, or an outage management system 180. For example, a single AMR system 100 may transmit a first signal across the telephone network 102 to a pager 140, notifying a technician of a power outage at the monitored electric meter 110. Simultaneously, the system may send a R/F transmission 101 to a billing system 170, notifying the billing system to temporarily suspend billing a customer's account until such time as the electric meter is repaired.

FIG. 2 shows a block diagram of an exemplary AMR system 100 in accordance with the present invention. As shown, the exemplary AMR system 100 includes a voltage input interface 202 and a current input interface 204. Voltage and current are received from a power line (not shown). As should be apparent to those of skill in the art, the input interfaces may be adapted for input from a single phase or three-phase power source. The voltage input interface 202 and current input interface 204 are coupled to an analog-to-digital conversion device 206, such as an RMS converter. Digital signals representing the converted voltage and current are then fed to the processor 208, where the utility usage readings are measured and processed in a conventional manner.

The processor 208 is controlled by firmware stored in the non-volatile data storage 214. Non-volatile storage 214 may include RAM and/or ROM and may be scalable in capacity. RAM may be programmable and re-programmable, so that operational parameters of the AMR system 100 may be changed. The non-volatile storage 214 may be re-programmed remotely through a communications device. Alternatively, non-volatile storage 214 may be re-programmed locally through an IRDA interface 224, or the like. As shown, the AMR system 100 may include additional components, such as: a reconnect/disconnect interface 119 for enabling re-connect and disconnect of utility services; a tamper detection device 116 operable to detect physical tampering with the AMR system 100; a power supply 212 and a battery back-up interface 210. Other components not shown may include an outage notification interface, a voltage monitoring interface and a temperature monitoring interface. Still other components will occur to those of ordinary skill in the art.

The AMR system 100 is equipped with a universal communications interface 228, which allows the system to communicate via any medium, such as: R/F, telephone, cable, fiber optics, satellite, power line carriers, etc. The universal communications interface 228 sends and receives data to and from a communications device (not shown), via ports or slots 230 and 232. Slot 1 230 and slot 2 232 each provide inputs and outputs for coupling with communications devices (not shown). Communications devices may be coupled to the slots 230 and 232 in any well known manner, such as through use of a circuit board or "card", a multi-prong connector (either male or female), a coaxial jack, or other manners apparent to those skilled in the art. Additional slots may be included for coupling additional communications

devices to the universal communication interface 228. The universal communications interface 228 also sends and receives data to and from the processor 108 via a universal bus 234.

In a preferred embodiment, the universal bus 234 comprises a 4-bit parallel bus. By using a 4-bit parallel bus, the AMR system 100 may transfer up to four bits of information simultaneously from the universal communications interface 218 to the processor 208, and vice-versa. This permits data from a single source to be rapidly transmitted to and from the processor. Further, the bus 234 may multiplex data transmissions originating from or sent to multiple sources. That is, rather than transmitting a single data bit from a single source interfaced with slot 1 230, then transmitting the next data bit from a second source interfaced with slot 2 232, the bus may simultaneously transmit data to or from up to four devices connected to the universal communications interface 218. For example, a R/F transmitter sending data to a remote location may be connected to slot 1 230, a transmitter operative to notify a pager upon voltage loss may be connected to slot 2 232, another transmitter operative to call a cell phone and play a prerecorded message upon tamper detection may be connected to a third slot, and so on. The universal bus 234 permits the processor 208 to send multiple bits simultaneously to a single device, thus speeding data transmission rates, or to communicate with several devices simultaneously, thus allowing signal multiplexing.

In alternate embodiments, the universal bus 234 may be an 8-bit bus, 16-bit bus, or bus of any other size without departing from the spirit and scope of the present invention.

Due to the fact that data generated internal to the AMR system 100 (i.e., the processor 208) will be digital and data generated external to the AMR system 100 may be analog, the universal

communications interface 228 may comprise analog-to-digital and digital-to-analog converters. The universal communications interface 228 may also comprise such components as a clock, a shift registers, multiplexers, and the like for facilitating the transfer of data between the processor and various types of communications devices. The universal communications interface 228 may include its own processor and non-volatile storage or may be controlled by the processor 108 and utilize the non-volatile storage 214 of the AMR device. Plug-and-play software or firmware may be stored in a non-volatile storage for enabling the universal communications interface 228 to recognize a communications device that is plugged into a slot 230 and 232. As mentioned, a non-volatile storage may be easily re-programmed for updating or adding plug-and-play software or firmware as needed.

Accordingly, the AMR system 100 of the present invention has the ability to send and receive data in ASCII code, DTMF signals, or any other type of signal or data transfer protocol. As an example of the advantages of the universal communications capabilities of the present invention, the AMR system 100 may transfer digital data directly to a digital computer, a fax machine, alphanumeric display cell phone, or a pager of a utility company without the need for a DTMF-to-ASCII converter at the utility company.

An exemplary embodiment of the present invention may be configured to individually or simultaneously read power, water and/or gas meters. When configured to read several meters simultaneously, an exemplary AMR system 100 is positioned at a central meter and additional remote circuitry is placed at one or more remote meters. The remote circuitry is programmed to collect data from a remote meter and to send the data to the AMR system 100 via

a communications device, such as an R/F modem. Data is then processed and transmitted from the AMR system 100 to a utility company via the universal communications interface 228.

Alternate embodiments of the present invention will become apparent to those having ordinary skill in the art to which the present invention pertains. Such alternate embodiments are considered to be encompassed within the spirit and scope of the present invention.

Conclusion

The AMR system 100 may include additional functionality not herein specifically described. For example, the system may accept to transmit signals in data formats other than those explicitly specified. The AMR system 100 may also have more or less communications slots than enumerated, or may have a universal bus 234 of a size other than four bits. Many other modifications and additional features will become evident in view of the preceding description of the embodiments of the invention. It should be understood, therefore, that the foregoing relates only to certain embodiments of the invention, and that numerous changes may be made therein without departing from the spirit and scope of the invention as defined by the following claims.

CLAIMS

I claim:

1. A method for transmitting a status message containing the current status of an input device, comprising:

receiving an input signal from the input device;

determining whether the input signal reaches a preset value;

in response to determining that the input signal has reached a preset value, initiating a status message;

determining the signal format of an output device;

in response to determining the signal format of the output device, formatting the status message to match the output device signal format; and

transmitting the status message.

2. The method of claim 1, further comprising the step of:

determining that a second output device exists;

in response to determining that a second output device exists, duplicating the status message as a second status message;

determining the signal format of a second output device;

in response to determining the signal format of the second output device, formatting the second status message to match the second output device signal format; and

transmitting the status message across the second output device.

3. The method of claim 1, wherein the input device is a utility meter.

4. The method of claim 1, wherein the input device is a radio frequency transmitter attached to a utility meter.

5. The method of claim 1, wherein the step of, in response to determining the signal format of the output device, formatting the status message to match the output device signal format, is performed by a universal communications interface.

6. A system for monitoring a utility status, comprising:

an input device, operative to transmit a utility status;

an input interface, operative to receive the utility status from the input device;

a microprocessor, operative to monitor the utility status received by the input interface and further operative to generate a status message based on the utility status;

a universal bus, operative to relay the status message from the microprocessor;

a universal communications interface, operative to receive the status message from the universal bus; and

a slot, operative to receive an output device, said slot connected by a data path to the universal communications interface.

7. The system of claim 6, wherein:

the microprocessor is further operative to generate the status message in a format untransmittable by the output device;

the universal communications interface is further operative to determine the signal format of the output device upon receipt of the output device by the slot; and

the universal communications interface is further operative to convert the status message from the original format to a format transmittable by the output device.

8. The system of claim 6, wherein the input device is a utility meter.

9. The system of claim 8, wherein the input signal is a voltage level.

10. The system of claim 11, wherein the input interface is an analog-to-digital converter further operative to convert the voltage level signal to a series of digital packets.

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11. A system for monitoring a utility meter, comprising:

an analog-to-digital converter, operative to receive a utility status from the utility meter, the analog-to-digital converter further operative to convert the utility status from an analog waveform to a series of digital packets;

a microprocessor, operative to monitor the utility status received by the input interface and further operative to generate a status message based on the utility status;

a universal bus, operative to relay the status message from the microprocessor;

a universal communications interface, operative to receive the status message from the universal bus, further operative to determine the signal format of the output device upon receipt of the output device by the slot, and further operative to convert the status message from an original format to a format transmittable by an output device;

a slot, operative to receive an output device, said slot connected by a data path to the universal communications interface.

METHOD AND SYSTEM FOR MONITORING AND TRANSMITTING UTILITY STATUS VIA UNIVERSAL COMMUNICATIONS INTERFACE

ABSTRACT OF THE DISCLOSURE

A method and system for monitoring utility meter status, and transmitting a status message via an output device connected to a universal communications interface in the event that the utility meter status meets a predetermined condition. Typically, the predetermined condition is a power loss, signified by a drop in voltage or current. The system is connected to a utility meter, such as an electric meter. The voltage level of the electric meter is monitored through a voltage input interface. An analog-to-digital converter transforms the voltage waveform into a series of digital data packets, which are then transmitted to a microprocessor. The microprocessor monitors the digital signal for a power loss indication, or other predetermined condition. Once a predetermined condition is met, the microprocessor transmits a status message across a universal serial bus to a universal communications interface. The universal communications interface is connected to at least one slot, which contains at least one output device. The universal communications interface is further able to determine the proper signal format employed by the output device for information transmission. Upon receipt of the status message, the universal communications interface converts the status message to the signal format employed by the output device, and passes the converted status message to the output device via the slot. The output device may then transmit the status message to a remote receiver in order to quickly and accurately update distant locations regarding the utility meter.

Fig. 1

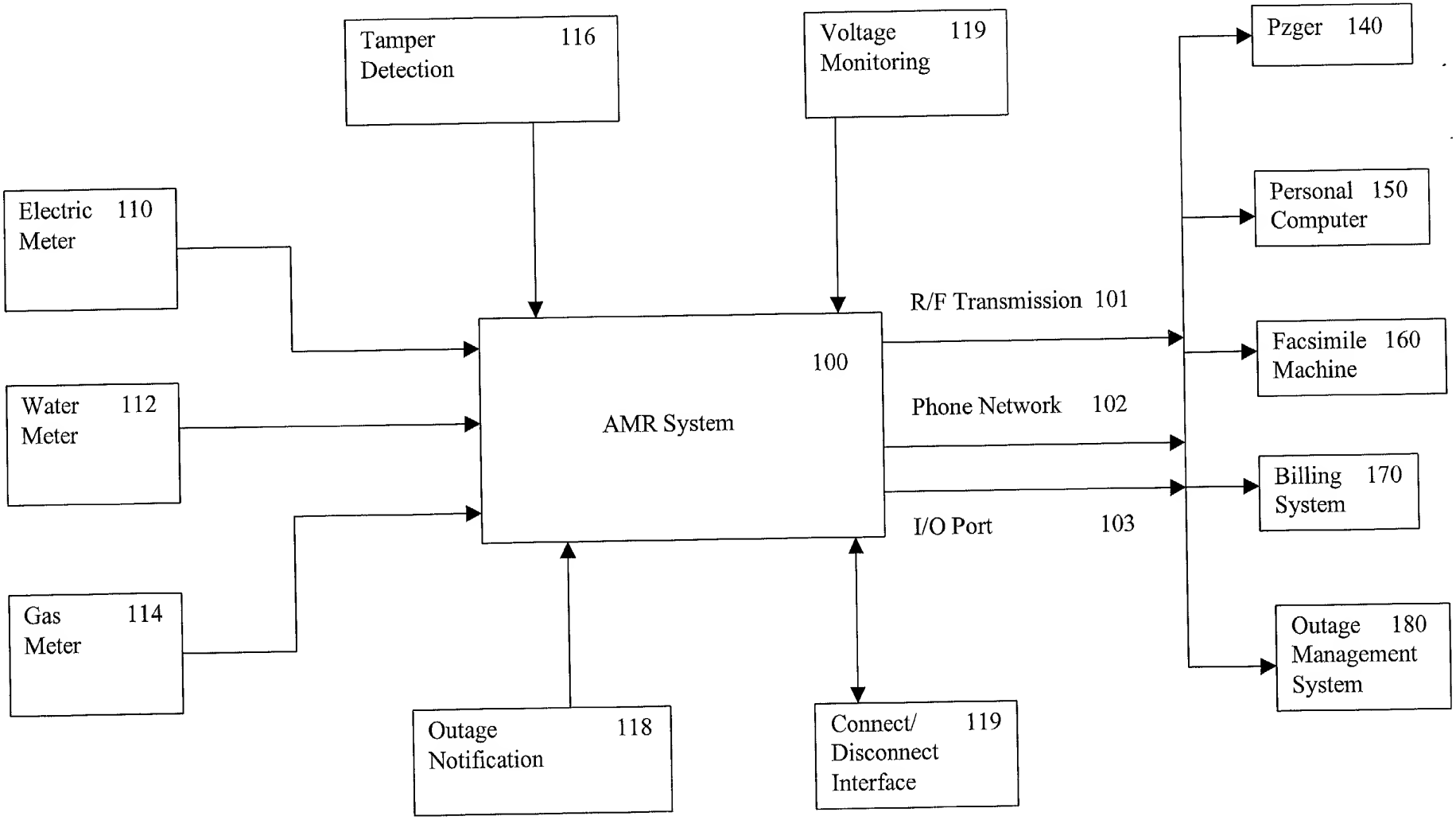
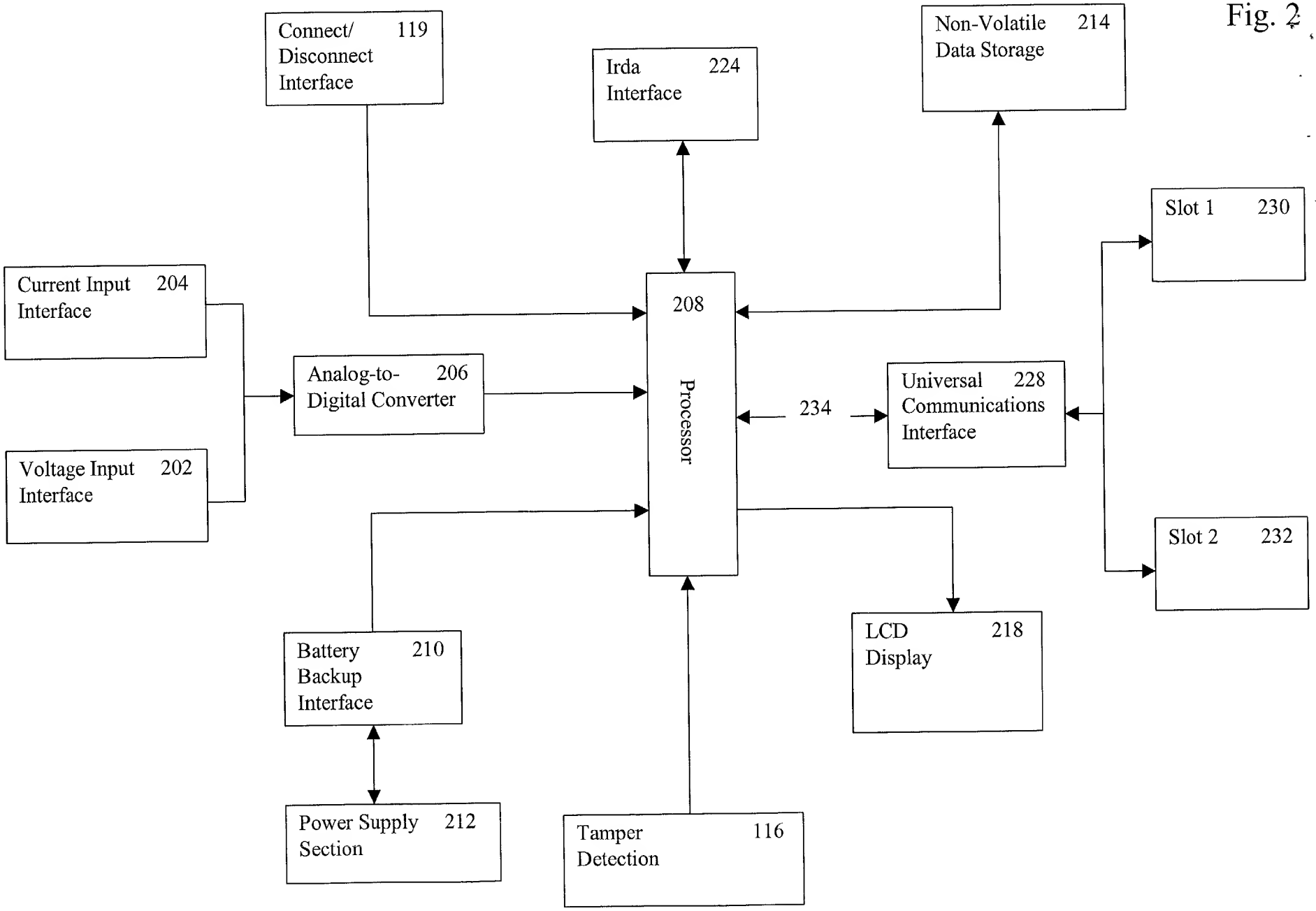

Tamper Detection 116
Voltage Monitoring 119
Pzger 140
Electric Meter 110
Personal Computer 150
R/F Transmission 101
100
AMR System
Facsimile Machine 160
Water Meter 112
Phone Network 102
Billing System 170
I/O Port 103
Gas Meter 114
Outage Management System 180
Outage Notification 118
Connect/ Disconnect Interface 119

Fig. 2


Connect/ Disconnect Interface 119
Irda Interface 224
Non-Volatile Data Storage 214
Slot 1 230
Current Input Interface 204
208
Processor
Analog-to-Digital Converter 206
234
Universal Communications Interface 228
Voltage Input Interface 202
Slot 2 232
Battery Backup Interface 210
LCD Display 218
Power Supply Section 212
Tamper Detection 116